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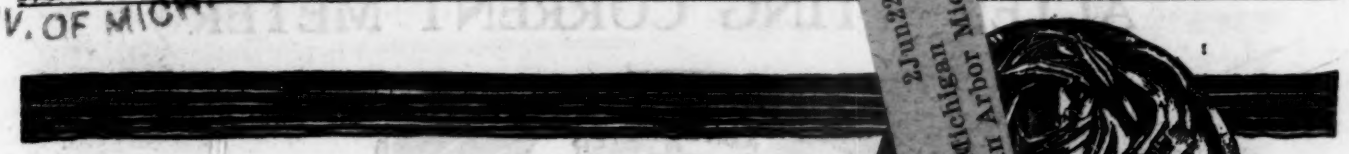

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SCIENCE

FRIDAY, AUGUST 19, 1921

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SOME PRESENT ASPECTS OF CHEMISTRY IN THE UNITED STATES[1]

IT has often been observed that those living in the midst of great events sometimes fail to understand the far-reaching effects of the occurrences going on around them. During revolutionary times attention is so riveted upon the single occurrences which follow each other with bewildering rapidity that the participants often fail to view the succession of events as a whole and thus miss their full significance. Revolution is scarcely too strong a word to apply to the changes relating to chemistry which are taking place in this country. The very great impetus which the science of chemistry has experienced during recent years brings with it a series of problems vitally related to the science as a whole, to our educational institutions and to industry.

It seems appropriate that on this occasion we might with profit, to borrow a business expression, take stock of the present situation. I shall therefore endeavor to give a brief and partial analysis of the outstanding features of the existing conditions, which are more or less confused, and lay down a few broad principles which appear to offer a sound basis of future development.

The events of the past five years have exerted a profound influence not only upon chemistry but upon various other sciences represented by the American Association for the Advancement of Science. To meet the critical situation presented in 1914 and the more critical condition in 1917, the country called to its service the entire scientific resources at its command and nearly every branch of science contributed something, either directly or indirectly, to aid in the solution of the pressing problems presented. The geologist was called

[1] Address of the vice-president and chairman of Section C, of the American Association for the Advancement of Science, Chicago, December, 1920.

upon to reexplore the natural resources of the country and to find, if possible, within our own borders raw materials which we had formerly imported, and many important and unexpected discoveries were made. The physicist was presented with a host of problems, problems in light, in sound, in electricity, in wireless transmission, etc., and in the attempt to solve these problems contributed materially to the advancement of our cause and to the general welfare. The engineer, working in conjunction with the physicist and chemist, gave body and substance to the discoveries of the latter, and gave besides an example of the power of concentrated and intelligent effort to solve engineering difficulties of all kinds, which won the admiration of the world. The various branches of medical science, represented by the physician, the surgeon, the physiologist, the pharmacologist and others, all rendered a service of inestimable value, the memory of which will long be enshrined in the thought of the world. I refer not only to the direct service in mitigating immediate human suffering, but also, and more important even than that, to the advances in medical science which were made. And so we might call the roll of the sciences and each could respond with a record of achievement, of things actually accomplished for the welfare of our country and the world.

It is perhaps true that no branch of science was given the opportunity of rendering more conspicuous or more vital service than that of chemistry. It is scarcely too much to say that for a period of two years the whole orderly course of scientific research in chemistry was suspended. In 1917 the country was confronted with a very large number of practical chemical problems, some of them of an extremely complex and difficult nature, the prompt solution of which was imperatively demanded. These problems may be grouped under two general heads. Since foreign sources were to a large extent cut off as early as 1914, we were faced with the task of supplying the ordinary everyday needs of the community for the vast number of substances in the manufacture of which chemistry played an essential part, and these problems were far from being satisfactorily solved in 1917. The second group included the multitudinous problems which had to do directly with the prosecution of war. In order to meet the situation thus presented the critical nature of which could hardly be exaggerated, practically the entire research and manufacturing facilities of the country were drafted. The extent to which the research personnel of the country was drawn into some branch of industrial or war work was truly amazing. Never before had this country witnessed such intensive chemical effort. For the industrial chemist it did not as a rule call for any very radical change in the nature of his work. To him it meant, in the main, redoubled effort in the line he was accustomed to, or in related lines. But for the large number of university men who were able to give a portion or all their time, the change was more radical. In many cases they abandoned, for the time being, the researches upon which they were engaged and addressed themselves to the solution of certain definite problems, not chosen by themselves, but presented by the exigencies of war. These men came from various colleges and universities in all sections of the country and for nearly two years gave themselves over to an entirely new experience, viz., an intensive study of definite problems which were essentially industrial in nature, in that they were in most cases directed toward ultimate large scale operation. After working out a particular problem in the laboratory it then became necessary, with the cooperation of the engineer, to put the process being developed through the various stages leading finally to large scale production.

The very great chemical activity which characterized this period and particularly the conspicuous success which was attained by the chemist in the solution of many of the difficult problems presented to him have had important results in several directions.

1. The chemist finds himself in a more favorable position than he formerly held in the eyes of the general public. It was not so very long ago that to the average man in the street,

the terms chemist and drug-clerk were synonymous. The educated non-technical man however was better informed. Asked for a definition of a chemist, he would reply, Oh! he is a curious fellow who can look at a rock and tell you what it is made up of! When one considers the fundamental importance of the work of the chemist to the everyday life of every individual in the community, that his work enters into everything he wears, eats, drinks, reads, works with and plays with, it is really astonishing that the public at large has had so little appreciation of him. It must be remembered, however, that in the past few opportunities were afforded to the average citizen, and no encouragement, to learn what the chemist meant to him. It was not so very long ago that the most widely disseminated chemical information was that furnished by the Sunday supplements of certain newspapers. And it will be recalled that they appeared to be particularly fond of describing such experiments as the extraction of gold from sea water, and others of a similar type, generally giving a more or less grotesque idea of the chemist and his work.

The education of the public as to the importance of chemistry to the community began in the fall of 1914 when it suddenly discovered that it was dependent upon other countries for many things chemical which were necessary to its daily comfort and convenience. And the temporary lack of things to which all were accustomed, and for which they were told to wait upon the chemist, did much to raise the latter in the public estimation. And when the promised articles began gradually to appear, in increasing quantity and with steadily improving quality, the chemist was still further raised in public esteem.

The second lesson came with the war. The ordinary citizen came to realize, as he had never done before, that in modern warfare the most powerful weapons of offense and the most effective means of defense are literally the products of the laboratories of scientists. Thanks to the introduction of what came to be known as chemical warfare, the late war became to a very large degree a contest between the chemists of the opposing countries. And a vivid knowledge of this fact was brought home to the people in a variety of ways.

Recoginzing the fact that, under a republican form of government, the widest possible dissemination of popular but exact information concerning a particular science is a matter of fundamental importance to that science, the American Chemical Society several years ago authorized and provided for the establishment and maintenance of an official news service, known as the American Chemical Society News Service. The chief function of this service is to furnish, at frequent intervals, to all the important newspapers throughout the country for publication, short popular articles on chemical subjects. The space given by the newspapers to these articles, while not all that might be desired, is gratifying in that it evidences an interest, and let us hope it will prove an increasing interest, on the part of the people generally in a subject which is of such great importance to the general welfare.

2. A second and very much more important change which has been taking place during the past five years is a growing appreciation of the value of research on the part of those concerned with chemical industry. Some of the larger and more progressive concerns, whose policies are dominated by men of scientific training, have long followed a liberal policy in regard to research. They have been sufficiently far sighted to recognize the possibilities of research in the utilization of by-products, the development of new processes and the improvement of old ones. Their experience has amply justified the financial wisdom of such a policy. A larger number of concerns have maintained research departments of a more limited scope, their activities being confined to the more immediate and obvious problems of plant operation. Then we have had a very considerable number of chemical plants in which no research chemists at all were employed. There has been in the past a surprising number of plants which were operated, in effect, upon the idea that

it would not be profitable to try to discover anything new about the chemistry of the processes being carried on.

Very rapid changes have been taking place in this respect during the past few years. The demand for research chemists in the industries has been stimulated by a variety of causes: the desire, in many cases at the instance of government, to increase output and extend operations into new lines, the stimulus to new enterprises afforded by the general shortage of chemicals, and, perhaps most important of all, the conspicuous success which has attended the efforts to solve various important and difficult chemical problems. It is worthy of note in this connection that in a number of instances discoveries of very great practical importance to industry have been made by university professors to whom contact with industrial chemistry brought about by war conditions was an entirely new experience.

Whatever other influences may have contributed, the result is that the industries are calling more insistently and for greater numbers of thoroughly trained and experienced research chemists than ever before and in consequence the universities and colleges of the country, along with other research institutions, are confronted with several very serious problems. In the main the Ph.D. graduates in chemistry, after completing their training, go into one of three lines of work. Some of them go into college teaching and in the past this field has absorbed a very considerable proportion of them. Others whose liking for pure research has been the determining factor in their choice have gone either into government service or to research institutions, educational and others. This choice has usually entailed being content, at least for a period of years, with a smaller financial return for their work than might have been expected in other fields. The remainder have gone into industrial work. As a result of the rapidly increasing proportion going into the last named field, the colleges particularly are finding it difficult and, in many cases, impossible to secure the services of properly trained men. Those connected with graduate institutions which are the source from which the colleges draw their teachers are in the best position to appreciate how serious the present condition is. Many times during the past twelve months the chemical department of the Johns Hopkins University has been compelled to reply to urgent calls for teachers that there were no men available. The seriousness of the situation is accentuated by the fact that, not only do the industries want the best and most promising men, but they are willing to pay larger salaries than the colleges and universities, with their limited endowments, can hope to pay and larger also than those obtaining in government research laboratories. The inducements offered by the industries are in fact frequently attractive enough to win over men all whose inclination is toward teaching and pure research.

There is another phase of the situation which is equally serious. Not only are the industries absorbing an undue proportion of young graduates, so much so that the universities and colleges find it impossible properly to fill various teaching and research positions, but in a good many cases they have invaded the research faculties in the universities themselves. To the university teacher the temptation to enter the industrial field is made very great by reason of the difficult economic situation in which he finds himself. The moderate increases in salary which have been recently granted by most of the institutions of the country have been entirely insufficient to offset the decreased purchasing power of the dollar and the economic position of the teacher, never particularly enviable, has been for the past three years considerably worse than formerly. The temptation to improve their economic positions has induced a number of men to abandon their university careers for industrial work, with consequent crippling of the research work of the institutions concerned. A perhaps larger number of university professors of chemistry have adopted a compromise. To supplement an inadequate income they have been devoting their summer vacations to industrial work, and in many

cases acting in an advisory capacity to their employers while they are carrying on their regular university work. The perils in such a situation from the standpoint of the university and the cause of pure science, some of them obvious and others not apparent, have been discussed several times and will be referred to a little later.

We come now to the consideration of another phase of the present situation. An active discussion has been going on for several years having to do with the general subject of the relation of the universities to the community. The particular part of this discussion with which we are concerned is that pertaining to the relation of the departments of chemistry in the university to the chemical industries.

However much some of us may be inclined to cling to our old ideals, I think most of us will agree that the idea long held of the university as a seat of learning for learning's sake is gradually giving place to a new conception of the university as a utilitarian institution. To appreciate the change that has already taken place one need only visit the class rooms of any large institution and see the handful of students taking Greek, for example, while in any subject having a direct practical utility, huge lecture rooms are filled to overflowing. Many colleges and universities have endeavored to uphold the old ideals and have continued to maintain the old chairs, and a few students continue to take these so-called cultural courses and always will so long as they are offered, but it remains true that the great majority of the students are interested mainly in those subjects which have a definite practical value. This is true of both graduate and undergraduate schools. And of necessity the departments dealing with subjects which are of practical value to the student in after life are receiving relatively greater, and increasingly greater, financial support from governing boards. Thus our higher institutions of learning, and particularly the graduate departments, are apparently tending to become, in fact, professional schools; that is, institutions in which men and women receive specialized training which fits them for a particular kind of work. This development is perhaps not so much the result of the adoption of a definite policy by those in charge of such institutions, but rather comes from the demand on the part of the students themselves. The students want such courses and, if a particular university will not give them, they will go elsewhere. The very great popularity of chemistry in the colleges and universities throughout the country is not due to a widespread scholarly interest in the science itself, but arises from the facts that chemistry is fundamentally related to the welfare of the community and that a thorough knowledge of the subject opens the door to an attractive profession.

We have already pointed out that most of the graduate students in chemistry in the universities may be grouped under three heads:

1. Those looking forward to professorships of chemistry in colleges, in which their chief work will be the teaching of chemistry to undegraduates, with limited opportunities for research.

2. Those looking forward to careers of research in pure chemistry, either in universities or other research institutions.

3. Those expecting to become industrial chemists.

So long as the university had to do mainly with students of the first two groups, there was no particular difficulty in providing suitable instruction for them without in any way endangering the ideals of the university laboratory as a place set apart from commercial considerations and devoted, with singleness of eye, to the cause of the advancement of science for the common good. The course of instruction generally adopted by American universities required for its completion three or more years' work subsequent to the bachelor's degree. A part of this time was devoted by the student to acquiring a knowledge of the fundamental facts and principles of the science, after which he was required to spend one or more years in actual research under guidance.

The rapid increase in the number of stu-

dents falling under group 3, that is, those who come to the university with the idea of going into industry, raises, in addition to those problems already referred to, a number of others of equally vital importance to the universities and to the industries themselves.

1. Unless all signs fail, the demand for chemists for the industries is not a temporary one, but will continue and in all probability increase. The country has definitely set out to develop its chemical industries, the goal sought being nothing less than chemical independence. The realization, even if it is not altogether complete, or falls short of our present hopes, will call for a continuous supply of chemists. The enhanced popular interest in the subject may also be expected to produce an increased demand for chemists in college and university positions. It seems certain therefore that the graduate departments of chemistry (and undergraduate as well), already in many cases among the largest in their respective institutions, must look forward to a considerable increase in the number of students applying for instruction each year. This will entail problems of enlargement of buildings and other additions to material equipment, increase of teaching personnel, possible additions of new courses, etc. But these are questions which mainly concern boards of trustees and I will not discuss them here.

2. A group of problems are presented having to do with the content of the courses offered for graduate students. The graduate courses that have been given in the past were developed along broad theoretical lines without particular reference to the training of men for the industrial field. The attempt was made to give the student as broad an acquaintance as possible with the basic facts and principles of the science of chemistry and in addition a knowledge and experience of the methods of research.

Now, inasmuch as the industries are dependent upon the universities for the training of the chemists which they require each year in increasing numbers, it is only natural that they should concern themselves with the character of instruction given. And inasmuch as one of the functions of the university is to train men for the industrial field it is only proper that those charged with the responsibility of this training should inquire whether or not the students are receiving the kind of instruction and experience that best fits them for their future work. The question therefore whether the chemical departments of the universities are giving the best kind of training to those who are to go into industrial work is entirely proper and the correct answer is of vital importance to the university, to the science of chemistry and to chemical industry.

Now there are a number of people among both teachers and employers of chemists, who believe that the present methods of university instruction could be materially changed to advantage so far as the future work of the industrial chemist and chemical industry are concerned and various suggestions have been put forward, most of them with the idea of making the work more "practical" in character. It is said that the present method and scope of university teaching make the Ph.D. graduate too theoretical and impractical; that when he goes into the plant he is at a loss because he has learned to think only in terms of small scale reactions and because he has no knowledge of engineering and therefore no appreciation of the mechanical difficulties that always appear when you go from the laboratory to large scale production. Hence it is concluded that the kind of chemist the industries need is one who is also an engineer. Hence the growth of a large number of institutions in the country in which a high-school graduate is put through a training embracing four or five years, taking various courses in mathematics, physics, engineering and chemistry, is given a bachelor's degree and sent into the industry. However valuable in a chemical plant men of this training may be, their outlook upon chemistry as a whole is entirely too limited to make them of any great value in the research laboratory. If our country is to realize its dream of chemical independence, our industries must have available and must employ large numbers of chemists of the highest quality, characterized by breadth

of chemical training, familiarity with chemical literature, enthusiasm for research and, above all, a thorough understanding of theoretical principles, which alone gives the investigator the ability to interpret observations and devise sound and effective methods of attack. The above qualities are essential to the research chemist, regardless of whether he is in an industrial or a university laboratory. For in the development of an industrial process, the first stage is in the laboratory and here the problem differs from a problem in "pure" research only in one particular, viz., that it is directed toward a definite commercial object. The same thoroughness should be sought, the same methods employed and precisely the same qualities on the part of the investigator are necessary.

Those of us therefore who are charged with the responsibility of university instruction in graduate chemistry should set our faces against the tendency in evidence around us to place the emphasis in teaching upon the practical, necessarily at the expense of the fundamentals.

This does not in any sense mean that university laboratories should avoid attacking problems the solution of which is of importance to industry. On the contrary, one of the happy developments of the past few years has grown out of the opportunity which has been afforded to large numbers of university professors to get in close contact with some of the problems of commercial chemistry. Many of these problems, of fundamental and far reaching importance to the industries, have been taken into the university laboratory and the professor brings to their study his ripe knowledge and experience, his patience and resourcefulness which, combined with the material facilities at his command, offer the promise of sure progress in their solution. Already substantial contributions along a number of lines have been made and we may confidently look forward to greater achievements in the future. The universities may very properly take advantage of the opportunities thus presented to render a high service to the community. But there are also dangers inherent in the situation. While rendering this service, we must sedulously avoid sacrificing the ideals of pure science. We must keep out of our university laboratories the spirit of commercialism and not allow our interest in these problems of applied chemistry to lessen our interest in the large number of even more fundamental questions which happen to be of less immediate practical importance.

In the foregoing discussion we have partly anticipated the answer to a question which has been frequently discussed in recent years. I refer to the matter of cooperation between the universities and the industries. How can the university laboratory render the most valuable service to chemical industry? How can industry cooperate with the university to the end that the interests of both may be best served? It must be clear that these interests are mutual; more particularly, that any plan which enables the university more effectively to perform its function of advancing scientific knowledge and training chemists will be beneficial to industry and anything which interferes with or in any way hampers the university laboratory in the performance of these primary functions must ultimately be harmful to industry.

Recognizing the importance of this question and fully conscious of the wisdom of properly guiding the movement already under way looking toward a closer relation between the universities and the industries, the American Chemical Society, under the recent presidency of Dr. Stieglitz, authorized the appointment of a committee to study and report upon the subject. The committee consists of leading educators and representatives of industry and I believe is still engaged in studying the question in the effort to formulate a plan by which the desired ends may be accomplished without injury to the university.

The opening paragraph of a tentative report made by the committee reads as follows:

> The most important contribution which the universities can make to the development of industry in this country is to supply the industries with sufficient numbers of men thoroughly and

broadly trained in the principles of chemistry. All other considerations must be subservient to this fundamental purpose.

This is a thoroughly sound principle and if it is accepted fully and made a guiding policy by both the university faculties and the industries it will constitute a touchstone by means of which the quality of any specific proposal may be tested. It must be clearly understood that if men are to be "thoroughly and broadly trained in the principles of chemistry" emphasis must be laid upon a good many things of which we can not *at present* point out any very direct practical application to industry. The fact is, however, that the number of these abstract questions emphasized by university teachers that have no bearing upon the problems of commercial chemistry is not nearly so large as the practical man believes. In other words, chemical industry lags considerably behind chemical science. The discovery on the part of industry that it has not been utilizing the chemical knowledge which has been available all along, carefully recorded in the literature, is really one of the outstanding events of the last five years. This is the explanation of the greatly increased demand for trained chemists. Their chief efforts will be directed, not so much toward original research, but rather toward applying what is already recorded to the practical problems of the plant.

The second paragraph of the report deals with "the strong tendency at the present to draw men, who have been particularly effective in research work, away from the universities by the payment of salaries far in excess of the salaries paid the same men in a university." In view of the considerable number of younger men of great promise who have in consequence been induced to abandon their university careers, the report goes on to say that "it seems evident that unless a very considerable increase in the salaries of teachers of chemistry can be secured, the next generation of chemists is likely to be trained by a set of mediocre men. Such a result would be disastrous to our industries and every possible effort should be made to meet this danger."

As to the various specific proposals for cooperation that have been put forward they should all be tested by the touchstone mentioned, and if this is conscientiously done it seems to me that no very great difficulty will be experienced in reaching wise decisions. There would seem to be no possible objection to the endowment of fellowships in the universities, similar to the duPont fellowships, which leave the student and the instructor entirely free in the choice of the subject of research and which carry no restrictions in the matter of publication of the results.

Fellowships designed to promote the solution of problems for the benefit of a particular industry, it seems to me, may be safely accepted by the university, but it should be clearly understood: (1) That the subject of investigation should be of fundamental importance to the industry as a whole; (2) that the instructor and student must be left entirely free in deciding upon the method and scope of the investigation; (3) that there must be no secrecy attached to the work; and (4) that the results should be published for the benefit of the industry as a whole within a reasonable time.

It seems to me that other kinds of fellowships proposed, of a private character, for example, a fellowship endowed by a single firm for its exclusive use, either for a limited or indefinite period, would be attended with grave dangers to the university. Aside from other considerations of equally vital importance, one of the most invaluable and inspiring features of the university research laboratory, viz., the entire freedom from restrictions which prevails, would be lost by the introduction of a system of private fellowships. Each worker, while he is interested mainly in his own particular subject, needs the inspiration which comes from contact with his fellow workers, and to deny him the privilege of learning what those around him are doing is to take from him a thing of inestimable value and for which there is no substitute.

B. F. Lovelace
The Johns Hopkins University

AN ANCIENT SKELETON DISCOVERED IN ECUADOR

DURING the month of May, while engaged in archeological work on the Ecuadorian coast, for the Museum of the American Indian Heye Foundation, the writer discovered, *in situ*, a complete human skeleton under conditions which indicate considerable antiquity. The find was made in the province of Esmeraldas, along the beach at a place 40 miles north of the equator called Tomsupa. This was the writer's third visit to the site, which he discovered in 1907. A brief account was published in his paper, "Archeological research on the coast of Esmeraldas, Ecuador," in the proceedings of the XVI. Internationalien Amerikanisten-Kongresses, Wien, 1909. In this paper attention was called to the character of the deposits, accompanied by a photograph of the same.

The skeleton recently uncovered was found in the bank a few hundred yards north of the place shown in the photograph, at a point where the alluvium is considerably deeper. All along the beach in the vicinity for some distance one finds deposits of human artifacts in the bank.

The region here is a plain bounded on the north by low hills which terminate at the sea in a point called Punta Chevele. To the south just below where the Atacames River empties into the sea there are also hills, and at the ocean is a rocky point called Punta Sua. From appearances it would seem that this plain, three or four miles wide, was formerly the dwelling place of numerous people, as we not only find here the Tomsupa deposits, but they are even more extensive at the southern limit along the banks of the Atacames River, and they also extend inland for some distance. It would seem that this plain later became the course of a great river, which gradually deposited gravel and alluvium to a depth of fifteen feet. Then came a washing away of the alluvium, more extensive to the south, as at present more than half of the plain along the beach is only slightly above high water mark.

In the paper above referred to are the following data about the Tomsupa deposits:

> The layer of pottery along the beach varies from 20 to 24 inches, and the measurements are as follows: alluvium and light earth, 16 inches; dark soil, ashes containing pottery and shells, 2 feet; sand to present line of beach, 1 foot.

At other places during our last trip deposits were found covered with 3 feet, and even 5 feet of alluvium. Skeletal remains were discovered nearby at a depth of 4 feet 7 inches under undisturbed alluvium.

Near the northern extremity of the plain is a ridge of alluvium running at right angles to the beach, which abruptly terminates at the north toward Punta Chevele, and from here on to the point the same conditions prevail as at Atacames, the plain being only slightly above high water mark. In this alluvial ridge there is a layer of stratified coarse gravel 12 feet from the surface, and this deposit extends southward for several hundred yards terminating with a covering of alluvium of three or four feet. This gravel deposit averages 2½ feet in thickness.

The skeleton to which attention is called in this communication was discovered at the deepest part of the ridge and under the gravel, being covered by 12 feet of alluvium, and 2½ feet of gravel. It was discovered by the writer's assistant, his son, Winthrop L. Saville, whose attention was drawn to a reddish knob just visible under the undisturbed gravel and alluvium. After the writer and his assistant excavated for a few minutes it was found to be a human leg bone. As night was coming on, a photograph was taken of the locality; the remains were carefully covered to protect them from rain and the carelessness of passers-by, for in this part of Ecuador the beach is the only highway. The next day the excavation was continued with some difficulty due to the extreme fragility of the bones and the nature of the high bank above, for the writer had far too little time at his disposal to permit of first cutting down the bank, and no laborers could be obtained at this place. We finally uncovered the remains of a young man just cutting his wisdom teeth. He had been buried

with the arms and legs bent close to the body, and the skull had been deformed with the frontal depression. The entire skeleton was tinged a bright red by the infiltration of iron, and the inner surface of the skull was covered by a deposit of brownish-black limonite. We were able to take out the skull, which fell into a hundred pieces, and only fragments of the bones. The only relic found was the foot of a pottery vessel with traces of a highly polished red inner surface. This was found near the skeleton above the bones and under the gravel. The skeleton was covered with earth, immediately below the layer of gravel and alluvium, and was not intrusive, there being absolutely no signs of disturbance above. It could not have been intruded from the side as there is rapid erosion going on here. Every year parts of the banks are washed away by the sea during the time of flood tides. The owner of the property assured the writer that the bank now visible is not the surface seen during former visits, as the ocean is slowly washing away the shoreline.

Concerning the age of this skeleton, the archeologist is not competent to pass his opinion. This must be done by the geologist and physiographer. But the writer is of the opinion that this find is the oldest burial thus far found in South America.

Marshall H. Saville

SCIENTIFIC EVENTS

THE MULFORD BIOLOGICAL EXPLORATION OF THE AMAZON BASIN

Further advices received from Dr. H. H. Rusby, director of the Mulford Biological Exploration, report continued favorable progress, and a considerable amount of scientific work already accomplished in quest for medicinal plants and biological specimens.

Members of the expedition left La Paz, Bolivia, about July 9, whence they proceeded by rail to Eucalyptus, the terminus of the railroad. From Eucalyptus to Pongo they traveled by auto truck over the new auto road recently completed by the Guggenheim interests in Bolivia. From Pongo, a three days' journey by mule brought them to Canamina, which will be their temporary headquarters for three or four weeks. From this point certain members of the party will make an ascent of the La Paz river for a considerable distance for the purpose of making special collections, the remainder of the party making detailed studies in the vicinity of Canamina.

Collections have been made in and around Mollendo, Arica, Arequipa, Tiavaya and La Paz. A large quantity of these materials, shipped just before the party left La Paz, has been received in Philadelphia.

The shipment includes among other things botanical specimens of economic products of Peru and Bolivia, such as the green-colored, purple-striped fruit of the "pepino"; the fruit of a species of *Tasconia* which is sold in the markets there under the name of "Tumbo"; also another edible fruit known as "acchocta," and a turnip-shaped root called "rhacache," and many others. These will go to the economic museum of the New York Botanical Garden and the Brooklyn Botanical Garden. A quantity of herbs is also included, which will be sent to Professor Edward Kremers of the University of Wisconsin, who will study the volatile oils contained in them.

In ascending and crossing the mountains from Mollendo to La Paz, Drs. Rusby and Hoffman made systematic observations on blood pressure changes at different altitudes and on the mountain sickness known as "sirroche." They have availed themselves of every opportunity to study tropical diseases and while at Arequipa they visited the fine hospital there to study a form of tropical ulcer known as "uta."

EDUCATIONAL FORESTRY

(*From a correspondent*)

Educational forestry is being carried on by experts at the Alleghany State Park, the new public recreation ground just dedicated in Cattaraugus county. The Buffalo Academy of Science is cooperating with the New York State College of Forestry in this work.

Henry R. Francis, professor of forest

recreation, and R. R. Fenska, professor of forest engineering, both of the forestry college, who are engaged in making a survey of the 65,000 acres of forested land contained in the tract, will lecture to visitors every Saturday in the Academy building at Tunesassa.

The talks will include a personally conducted hike through the forests and a study of the flora and fauna encountered on the trip. Valuable information about birds, woods and wild animals common to that section of the state will be given by the experts, something that every person who goes into the woods should know. The hike will be followed by an illustrated talk on forestry, particularly as the subject pertains to the best use of the woods for recreation and health. The lectures will be given every Saturday until the vacation season ends.

The efforts of the commission headed by A. T. Fancher, of Salamanca, to make this great forested region of mountains and valleys and picturesque trout streams one of the most attractive in the United States are bringing forth excellent results. The large number of tourists and campers who already have been attracted to the park show the importance and popularity of forest recreation.

LECTURES AT THE UNIVERSITY OF MICHIGAN

THE following program of scientific lectures has been given for the students of the summer session of the University of Michigan.

July 5—*Fever,* Dr. C. W. Edmunds, professor of therapeutics and materia medica, University of Michigan.

July 12—*Causes of mental disorder,* Dr. A. M. Barrett, professor of psychiatry, University of Michigan.

July 14—*Niagara Falls and vicinity* (illustrated), Assistant Professor K. C. McMurry, department of geology, University of Michigan.

July 18—*The asteroids and rings of Saturn,* Mr. L. A. Hopkins, assistant professor of mathematics and secretary of the colleges of engineering and architecture, University of Michigan.

July 19—*The nature of cancer,* Dr. A. S. Warthin, professor of pathology and director of the pathological laboratory in the medical school, University of Michigan.

July 22—*How the psychologist tests intelligence* (illustrated), Mr. Guy M. Whipple, professor of experimental education, University of Michigan.

July 26—*Practical points in the prevention and treatment of cancer,* Dr. C. V. Weller, assistant professor of pathology, University of Michigan.

July 29—*Michigan's inland lakes: their value to the state* (illustrated), Mr. I. D. Scott, associate professor of physiographical geology, University of Michigan.

Aug. 1—*The senses and the learning process in fishes* (illustrated), Dr. J. E. Reighard, professor of zoology and director of the zoological laboratory and the zoological museum, University of Michigan.

Aug. 2—*Stone in the kidney,* Dr. Hugh Cabot, dean of the medical school, University of Michigan.

Aug. 4—*The nature of intelligence,* Professor L. L. Thurstone, of the Carnegie Institute of Technology.

Aug. 8—*Functions in high-school mathematics,* Professor E. R. Hedrick, University of Missouri.

Aug. 9—*Junior-high-school mathematics,* Professor E. R. Hedrick.

Aug. 10—*The conservation of health through food and drug inspection,* Professor C. C. Glover, secretary of the college of pharmacy, University of Michigan.

Aug. 12—*Acoustics of auditoriums* (with experimental demonstrations), Assistant Professor D. L. Rich, department of physics, University of Michigan.

Aug. 17—*Modern theories of matter* (illustrated), Dr. E. F. Barker, department of physics, University of Michigan.

Aug. 19—*Ten years of heredity* (illustrated), Professor A. F. Shull, department of zoology, University of Michigan.

BOOKLETS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE office of the permanent secretary of the American Association for the Advancement of Science has recently published two booklets that should be of interest to workers in science and other friends of science. The first of these, entitled "Resolutions bearing on Important Features of the Public Welfare," includes five resolutions that have already appeared in the pages of SCIENCE, and it also presents the list of general officers of the as-

sociation for the calendar year 1921. The second is "A Booklet of General Information, specially announcing the Second Toronto Meeting," which is to occur December 27–31, 1921. It includes preliminary information regarding the second Toronto meeting, with notes on the city of Toronto, and presents a succinct statement of the "Organization and work of the association." The latter topic is discussed under the following headings: "General scope," "Meetings," "Endowment and grants for research," "Publications," "Co-operation with other organizations," "Financial aspect of the work of the association," and "Conditions, obligations and privileges of membership and fellowship."

The last cover page of this booklet bears an instructive graph showing the growth of the membership list from 1848 (461) to 1920 (11,442). Copies of these booklets may be obtained from the permanent secretary's office.

SCIENTIFIC NOTES AND NEWS

Dr. George E. Hale, director of the Mount Wilson Observatory of the Carnegie Institution, was elected president of the Pacific Division of the American Association for the Advancement of Science at the recent Berkeley meeting.

At the opening meeting of the second International Congress of Eugenics, which will be held at the American Museum of Natural History, New York City, on the evening of September 22, addresses will be made by Professor Henry Fairfield Osborn, president of the congress; Major Leonard Darwin, president of the Eugenics Education Society, London; and Dr. Charles B. Davenport, director of the Department of Genetics of the Carnegie Institution.

The Paris Academy of Medicine has elected as foreign correspondents Professor L. J. Henderson, of Harvard University; Sir Robert Philipp, of Edinburgh; Sir Humphry Rolleston, of London; and Sir d'Arcy Power, of London.

At the June meeting of the Royal Society of New South Wales, Mr. R. T. Baker, curator and economic botanist of the Technological Museum, Sydney, was presented with the Mueller medal awarded to him by the Australasian Association for the Advancement of Science for his services to botany, particularly in regard to the Eucalypts.

Dr. R. Robles, of Guatemala, has been made a chevalier of the Legion of Honor by the president of the French Republic, in recognition of his discovery that the disease known in Central America as "coast erysipelas" is transmitted by a filaria.

Dr. Julius Lilienfeld, professor of physics at the University of Leipzig, has arrived in New York, where he has recently given a demonstration of his new roentgen-ray tube before the New York Roentgen Ray Society.

Dr. A. J. Hill, of New Hampshire, for twenty years a member of the Census Bureau and for several years chief statistician, has been appointed assistant director of the census.

Governor Sproul, of Pennsylvania, has appointed Dr. John M. Baldy as commissioner of welfare under the law which was passed at the last session of the legislature. The law creates a department of welfare to take over the work of the old state Board of Public Charities, the Lunacy Commission, the Prison Labor Board and other related activities. Dr. Baldy has been president of the State Board of Medical Education and Licensure since its creation in 1911, and is succeeded in this office by Dr. Irvin D. Metzger, Pittsburgh.

The British Civil List pensions granted during the year ended March 31, 1921, as reported in *Nature*, amounted to 1,200*l.*, and include the following: Mrs. Frederick Enock, in recognition of her husband's services to natural science and entomology, 100*l.*; Mr. Edward Greenly, in recognition of his services in the geological survey of Anglesey, 80*l.*; Mrs. J. A. McClelland, in recognition of her husband's distinguished services as an investigator in physical science, 100*l.*; Mrs. and Miss Sharman, in recognition of Mr. George Sharman's valuable services in palæontological science, 80*l.*; Mr. John Nugent Fitch, in recognition of his long services to the cause of

botany, horticulture, and natural history, 75*l.*; Mr. W. R. Hodgkinson, in recognition of his valuable scientific work in the public service, 100*l.*; and Mr. Herbert Tomlinson, in recognition of his services as a teacher, and of his valuable and distinguished contributions to physical science, 100*l.*

THE title of emeritus professor of philosophy and comparative psychology in the University of London has been conferred on Mr. Carveth Read.

A STATUE of Donders, the great Dutch ophthalmologist and physiologist, was recently unveiled at Utrecht where he had been professor of ophthalmology and of physiology until his death in 1889.

ACCORDING to the *Journal* of the American Medical Association, a tablet has been placed in the provincial hospital at Madrid commemorating the work of Dr. Achúcarro, the promising young histologist whose untimely death occurred a few years ago.

THE name of Virtudes street in Havana has been officially changed to "Mayor Gorgas," and metal plates with the new name have been affixed.

A TABLET with a portrait medallion of Sir William Ramsay, by Charles L. Hartwell, will be placed in Westminster Abbey as part of the Ramsay memorial.

GEORGE TRUMBULL LADD, professor and emeritus professor of philosophy at Yale University for forty years, died on August 8, at the age of seventy-nine years. Dr. Ladd was the author of important books on philosophy and a leader in the development of physiological and experimental psychology.

DR. O. SCHMIEDEBERG, formerly professor of pharmacology at the University of Strasbourg, has died at the age of eighty-three years.

AN examination for scientific assistant ($1,400 a year) in the United States Bureau of Fisheries, will be held on September 21. Applicants will be rated chiefly upon zoology in its relation to the fisheries, and general biology.

A BILL to create a Department of Health has been introduced in the Japanese House of Representatives, in order to bring the various health organizations of the empire under the control of one department.

AN Institute of Pathological Anatomy, named after Professor Hlava, has recently been inaugurated at the University of Prague. The institute is described as being the largest and best equipped of its kind in Europe.

THE Committee of the Fifth Cuban Medical Congress, which will be held in December next, has decided to invite American, French and Spanish physicians and surgeons to attend.

AN international exhibition for the promotion of hygiene will be held at Amsterdam, Holland, from October 8 to November 8. The exhibition includes the following: Feeding, clothing, housing, bodily cleanliness, labor hygiene, sport, dental care, infants' care, nursing, food adulterations, quack remedies, alcoholism, anti-tuberculosis movement, malaria, typhus, sex diseases, tropical hygiene, historical section. Apart from the above, there will be a commercial exhibition of clothing, foodstuffs and their packing, housing devices, wall and floor coverings, washstands, bathroom fixtures, kitchen utensils, suction sweepers, baby clothing, baby articles, sport clothing, sport articles, surgical instruments, dressing, equipment for operating rooms, dentists' and oculists' equipment, etc. Further particulars may be had from the Netherlands Chamber of Commerce, Beaver Street, New York City.

THE *Journal* of the American Medical Association states that in the 1921 budget of the German government department for science and art, one specification is for 800,000 marks to continue the study of the Friedmann remedy for tuberculosis. Already several hundred thousand marks of government appropriations have been spent on the committee conducting the research. The *Deutcshe medizinische Wochenschrift* is quoted as remarking that it would be better to devote the money to maintaining the sanatoriums which are closing their doors for lack of

funds. The social insurance authorities have had to close the children's sanatorium at Lichtenberg and dismiss the personnel, and the full utilization of the great sanatorium at Beelitz is threatened.

The Henry Phipps Institute of the University of Pennsylvania has received a grant of $25,000 a year from the Carnegie Corporation, and $25,000 for two years from the university trustees. The conditions which must be met that advantage may be taken of the Carnegie grant are, first, the grant itself be expended for research, and second, there shall be previously expended for research not less than $50,000 a year, derived from other sources, in any year in which this grant is claimed.

A correspondent writes: "Dr. E. H. Sellards, geologist in the bureau of economic geology of the University of Texas, has been given leave from the University in order to undertake geologic investigations for the State of Texas in the Attorney General's Department relating to the Texas-Oklahoma boundary line on the Red River. The United States Supreme Court has held that the treaty of 1819 between the United States and Spain made the south bank of Red River the boundary between the two countries, and that by subsequent treaties and congressional acts this line as defined by the treaty with Spain has become the boundary line between Texas and Oklahoma on the Red River. However, there remain undetermined the questions: What constitutes the south bank of this river; where was the south bank approximately one hundred years ago when the treaty with Spain was made; and by what process has the river departed from its position of one hundred years ago, that is has the river moved gradually as by accretion to its banks, or suddenly as by ovulsion. The actual location of the boundary line between the two states for a distance of three hundred miles or more is contingent upon the Supreme Court's decision on these points to be made in accordance with the evidence that may be presented."

UNIVERSITY AND EDUCATIONAL NEWS

Vassar College receives $150,000, and Barnard College, Yale University, the University of Rochester and Colgate College, $10,000 each, by the will of the late Dr. Henry M. Sanders, formerly pastor of the Madison Avenue Baptist Church, of New York City.

Dr. P. P. Claxton, recently United States commissioner of education, has accepted the provostship of the University of Alabama.

Secretary Weeks, of the Department of War, has asked the University of Pennsylvania to release Major General Leonard Wood from his promise to become provost of the university in order that he may be free to accept the governor generalship of the Philippines.

As an *ad interim* measure, Dean Stanley Coulter has been appointed chairman of the faculty of Purdue University by the board of trustees and will administer all academic interests, while financial matters will be handled by a member of the board.

Dr. Charles D. Snyder has been appointed professor of experimental physiology in the Johns Hopkins University.

Dr. John C. Donaldson has accepted appointment as assistant professor of anatomy in the school of medicine of the University of Pittsburgh.

DISCUSSION AND CORRESPONDENCE

ANOTHER HIGH-TEMPERATURE RECORD FOR GROWTH AND ENDURANCE

A temperature record for growth and endurance of developing joints above that of any previously given was published by the senior author in Science for April 15, 1921. Young joints of *Opuntia* were found to continue elongation at 55° C. (131° F.) and to endure this temperature so that development was continued normally at lower and accustomed temperatures in March at the Desert Laboratory.

Measurements on other individuals with the advance of the season confirmed the earlier

results and have established a new high-temperature limit for active protoplasm in higher plants, also a new endurance record. The principal facts are as follows:

1. Joints of *Opuntia* were observed to maintain a fair rate of enlargement when at a temperature of 56.5° C., the air surrounding them being at 58° C. (137° F.).

2. Growth of young joints of *Opuntia* the temperature of which rose to 62° C. (144° F.) in an air temperature of 63° C. (146° F.) stopped and some shrinkage ensued, but growth or enlargement was resumed when their temperature fell to 50° C.

3. The young joints which were subjected to these temperatures were about 15 to 20 mm. in width and 25 mm. in length, and after being held at or near the record temperatures for an hour or more, which was repeated in one case, carried forward normal development, reaching maturity at a normal average of 100 mm. in width and 130 mm. in length.

4. It is to be noted that data from observations in which temperatures were taken from the air or from water in which the roots or aerial parts of plants were immersed, have but little value in any estimation of the working temperature of active protoplasm by reason of the abnormal hydration and transpiration conditions introduced. These conditions as well as the proportions and state of the main colloidal components must determine the temperature effects.

D. T. MACDOUGAL,
EARL B. WORKING

DESERT LABORATORY,
TUCSON, ARIZONA

A CALCULATOR FOR CONVERTING GAS CHAIN VOLTAGE INTO EQUIVALENT C_{H^+} OR p_H VALUES

IN the determination of hydrogen-ion concentrations by electrometric methods employing the hydrogen electrode, the step of finding the C_{H^+} or p_H value from the measured voltage, with the aid of the working formula, though not difficult, is time-consuming. The extensive tables of Schmidt and Hoagland[1] simplify the process considerably. They give, in parallel columns, the voltages measured between a hydrogen electrode and a tenth-normal, and between the hydrogen electrode and a normal calomel electrode, respectively. With these are given the corresponding p_H, C_{H^+} and C_{OH^-} values, respectively. If the calomel electrode — because of difference in concentration of its potassium chloride solution, for example — has a different value, against the normal hydrogen electrode, from those assumed in these tables, a simple computation is necessary.

By definition, $p_H = -\log C_{H^+}$, and the working equation, derived from Nernst's equation, shows these quantities to be linearly proportional to the measured voltage. If in all cases we had to deal with a single unvarying reference potential, the simplest procedure would be to draw the straight line, expressing the relationship, on a chart of rectangular coordinates, and to use this as the conversion chart. This plan, however, is not practicable in its application to all cases, because of the preferences of different workers for different types of reference electrodes.[2] Some prefer the tenth-normal, others the normal, still others the saturated type. In any given type, there are likely to be minor differences between different electrodes. To be able to apply the graphic chart to all cases requires that the straight line be capable of being shifted, parallel to itself at any one temperature, to correspond to the fundamental potential of the reference electrode being used.

Since it is a straight line relationship with which we are dealing, and since the variations mentioned do not change the slope of line, an instrument of the slide-rule pattern is not only feasible, but highly practicable. For convenience, the circular type was chosen. The C_{H^+} and p_H scales are engraved on a disk 125 mm. in diameter. From the relation between these two quantities, their main divisions coincide; *e.g.*, for $p_H = 8$, $C_{H^+} = 10^{-8}$.

[1] Univ. of Cal. Pub. in Physiol., 5, 23, 1919.

[2] A graphic conversion chart of the kind mentioned is reproduced in "Electrometric Methods and Apparatus for Determining Hydrogen-ion Concentrations," L. & N. Co., 1920, p. 25.

Of these main divisions there are 14, covering the entire range from normal acid to normal alkaline reaction. The 125 mm. disk is mounted by means of a central pivot on a second disk, having its scale of voltage around the circumference of the first. The range of the latter extends from 0.24 to 1.17 volts. Concentric with the disks is a movable arm of transparent celluloid, with a radial hair-line scribed upon it, to facilitate making readings. The points on the voltage scale corresponding to the potentials of tenth-normal, normal and saturated KCl calomel cells are marked, as a matter of convenience. The temperature for which the slide-rule gives correct readings is 25° C.

To use the instrument, the zero mark of the circular scale is set on the voltage corresponding to the reference electrode being used. The hair-line is set to indicate the measured voltage, and the corresponding p_H and C_H readings appear under the hair-line on the inner disk. Settings are possible to an accuracy of ± 0.5 millivolt.

The slide-rule can be used equally well when the reference electrode, instead of being the usual calomel half-cell, is a hydrogen electrode of known potential relative to the standard solution in which it is immersed. Whatever the nature of the fixed electrode, the change in potential difference at the terminals of the gas chain is 59.1 millivolts for each decimal change in the concentration. The graduation of the inner disk is based upon this assumption, which makes it applicable to any case.

Because of the fact that so few data are available on the variations of gas chain electromotive forces with temperature, it seems advisable, pending an accumulation of reliable information on this point, to make measurements at a temperature of 25° whenever this is possible.

Paul E. Klopsteg

MATHEMATICS IN SPANISH-SPEAKING COUNTRIES

The Spanish-speaking countries publish only one journal devoted to advanced mathematics, which is now called *Revista Matemática Hispano-Americana* and is published at Madrid, Spain, under editorship of J. Rey Pastor. In view of the fact that the professors of mathematics in so many countries can obtain no other advanced mathematical journal in their own language one might suppose that this periodical would not suffer for want of suitable manuscripts or sufficient financial support.

Such a supposition is, however, not in accord with the facts, judging from a call issued recently by its editor. In this call it is stated that there is now an almost complete lack of Spanish mathematical production and that it has been necessary therefore to publish an excessive number of articles by the same authors. It is also stated that nearly all Spanish professional mathematicians occupy the position of spectators and critics, and thus place the burden of doing the work connected with the periodical on the shoulders of one or two men.

In view of the fact that in the English-speaking countries of America the mathematical journals are now overcrowded by suitable manuscripts offered for publication it is interesting to note that just the opposite is true in the Spanish-speaking countries of this continent. As was noted in Science, N. S., volume 34, page 372, the Spanish-speaking people organized a mathematical society in 1911. This society has been fairly successful in awakening among them an interest in the newer fields of mathematics, but, judging from the call noted above, which was directed to the members of this society, it seems that this interest is still far from being general and effective.

G. A. Miller

University of Illinois

THE EARLIEST BEES, WASPS AND ANTS

It seems desirable to correct some statements appearing in text-books of geology, which lead students to imagine that we are acquainted with bees, wasps and ants from Mesozoic strata. Thus, Professor J. W. Miller,

in his "Introduction to Historical Geology" (1916), says (p. 232):

> Insects such as bees, ants and wasps made their first appearance in the Jurassic.

Dr. C. Schuchert, in "Historical Geology" ("Text-book of Geology," part 2), 1915, p. 812, states that "with the Comanchian . . . insects (beetles, flies, ants, bees, wasps) took their rise." As a matter of fact, the oldest known bees are from Baltic amber (Oligocene Tertiary), and the oldest known true wasps and ants are from the Eocene. In the Jurassic, the peculiar family Pseudosiricidæ, apparently related to the modern Siricidæ, were well represented. One species of this extinct family (*Megapterites mirabilis* Ckll.) has lately been described from the English Eocene. There is a very dubious Jurassic Hymenopterous insect from Spain, supposed to be related to the Ichneumonidæ. These Hymenoptera were not in any way adapted to be pollinators of flowers. Considering the development of the Hymenoptera in the Eocene, it may be presumed that the wasps and ants, at least, originated as early as the Cretaceous, but there is no direct evidence on the point.

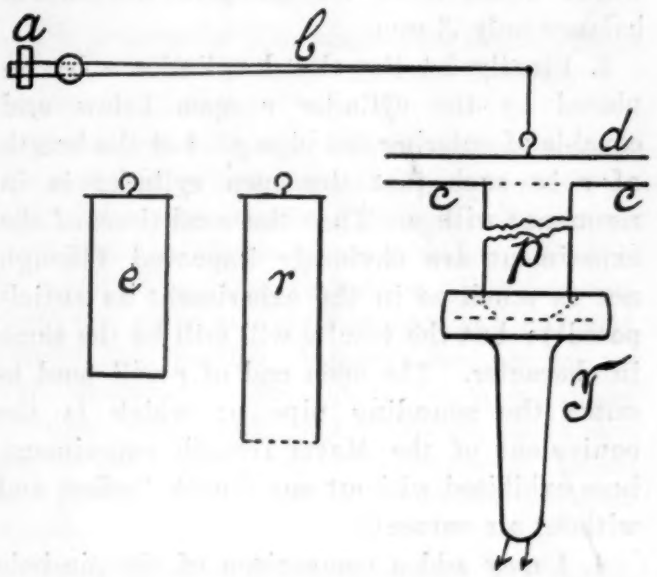
T. D. A. COCKERELL
UNIVERSITY OF COLORADO

SPECIAL ARTICLES

THE PNEUMATIC PARADOX IN ACOUSTICS

1. THE following pretty experiment is very instructive in its bearing on the Mayer-Dvorak effect, as well as on the experiments of the present paper. In the figure, *b* is the light wooden beam (30 cm. long, counterpoised at *a*) of a horizontal torsion balance, the torsion wire (of brass, .02 cm. in diameter and 18 cm. long on either side normal to the diagram) being seen at *w*. A light disc of cardboard *d* is suspended in equilibrium from the end of the balance. Below this is the telephone *T* to which the brass pipe *p* (13 cm. in length and 2.6 cm. in diameter) has been cemented, to form of a closed *c″* organ pipe of which the telephone plate is the bottom. The open top of *p* is surrounded by a fixed annular disc *cc* of metal parallel and close to the movable disc *d*.

When the telephone is strongly energized and emits a rising note (motor break and rheostat), no effect is produced until its frequency is in resonance with the pipe *p*, whereupon the disc *d* is at once attracted. Since the pipe *p* is closed above by this process, the telephone frequency must be slightly reduced to keep the discs in cohesion. On breaking the current *d* is at once released.



This is of course nothing further than a modified example of the familiar pneumatic paradox. When the pipe howls, the distance from which *d* may be attracted and held is perhaps 2 cm. beyond which the couche of diminished static pressure is ineffective. The thickness vanishes with the intensity of sound.

2. If now *cc* is removed and the disc *d* is replaced by the closed paper cylinder *e* of a diameter (2.1 cm.) sufficiently small to enter the mouth of *p* easily, the results of the experiment are the same. Here however the cylinder *e* may be made to enter the pipe as much as 1 cm. or more by successively decreasing the pitch, conformably by the gradually stopped mouth of *p*. Supposing the total displacement to be 2 cm., the force indicated by the torsion balance would be .7 dyne and the mean pressure decrement for the area 3.5 cm.², therefore .2 dynes/cm.² But as both the disc and cylinder come down with a jerk, the maximum forces are probably larger.

If there were a pin hole in the bottom of *e*,

the density of air contained would tend to increase and the cylinder fall for this reason also. But the present experiment is relatively too crude to show this. For the content of the cylinder e (6 cm. long) may be taken as 33 milligrams of air. The forces registered by the pinhole valve in experiments with resonators did not exceed $dp \mid p = 3 \times 10^{-4}$. Thus the increment of weight of e is but 10^{-2} dyne, which would lower the index of the torsion balance only .3 mm.

3. Finally let the closed cylinder e be replaced by the cylinder r open below and capable of entering the pipe p. Let the length of r be such that the open cylinder is in resonance with p. Then the conditions of the experiment are obviously improved (though not as much so in the experiment as anticipated[1]); but the results will still be the same in character. The open end of r will tend to enter the sounding pipe p; which is the equivalent of the Mayer-Dvorak experiment, here exhibited without any "neck" effect and without air currents.

4. I may add a comparison of the pin-hole compression observed in the given pipe (2.6 cm. diameter and 13 cm. long) when sounding loudly (*i.e.*, when resistance in the telephone circuit has been reduced as much as possible) and the compression observed in the open organ pipe of the standard form on the interferometer. The embouchured organ pipe, tested on the interferometer,[2] showed for the maximum compression $d\rho \mid \rho = 10^{-3} \times 14$ in case of a moderately loud note. The telephone closed pipe, tested with the pin-hole valve at the end of a quill tube thrust well within, gave a displacement of 20 fringes with 2,000 ohms in circuit. This is equivalent to a pressure increment of .0120 cm. of mercury when but 100 ohms are in circuit, as was approximately the case in the experiments of this paragraph. Thus in case of the probe $dp \mid p = 1.6 \times 10^{-4}$. Reservoirs at the U-tube of different volumes showed the same quantitative result. The increment (compression) does not quite vanish even in the plane of the mouth of p, but a little beyond. The ratio of the two compressions is thus 87; but while the interferometer direct gives a fringe displacement rarely exceeding 1, the pin-hole valve, under like conditions, will give fringe displacements easily several hundred times larger, depending on the degree of approach to the critical diameter of the pin hole.

Carl Barus

Brown University, Providence, R. I.

[1] On varnishing the paper resonator to stiffen it, forces above 2 dynes per cm.[2] were directly measured.

[2] Science, LII., p. 47.

THE KENTUCKY ACADEMY OF SCIENCE

The Kentucky Academy of Science held its eighth annual meeting on May 14th at the University of Kentucky, Lexington. The meeting was called to order at 9:30 o'clock by President Coolidge.

The secretary's report showed 127 members, including 44 national members, 55 local members, 21 corresponding members and 7 honorary members. These represent 37 different lines of activity of which chemistry leads with 26 members. Twenty-one new members were elected.

The report of the committee on legislation proposed a large program to be worked for, including a state appropriation for the support of the academy; awarding prizes for research; increased appropriations for completing the topographical map of the state and soil surveys; a natural history survey of the state and the establishment of a natural history museum; increase in the teaching of science in the high schools; the preservation of the records of drilled wells; the setting aside of areas for preserving natural conditions and the endorsement of the law now before Congress to make Mammoth Cave and its environs a national park. This report was adopted.

The officers elected were:

President, George D. Smith, State Normal School, Richmond, Ky.
Vice-president, Lucien Beckner, Winchester, Ky.
Secretary, A. M. Peter, Experiment Station, Lexington, Ky.
Treasurer, Charles A. Shull, University of Kentucky, Lexington, Ky.
Member of Publications Committee, D. W. Martin, Georgetown College, Georgetown, Ky.
Representative in the Council of the A. A. A. S., A. M. Peter.

The program included an address by Dr. Henry

B. Ward which was the principal feature of the afternoon session.

The following program was rendered:

President's address: *The relation of chemical training to industry:* W. H. COOLIDGE.

An experiment in mental and physical correlation: J. J. TIGERT, University of Kentucky, Lexington, Ky. By title.

Summary of the Thurstone intelligence tests for college freshmen and high-school seniors: WALTER E. ERVIN, Centre College. The average of 58 freshmen tested was 83, ranging from 30–39 (one student) to 150–159. The author remarks that such tests are not conclusive as to the mental equipment of any boy or girl, but they are helpful by placing the student in the school with more fairness.

The tragedy of the passenger pigeon: GEORGE D. SMITH, Eastern Kentucky State Normal School. The author described his observation of the wholesale destruction of the pigeons in their roosting place in a marsh, at night, by persons who came for miles around for this purpose, and hauled away the dead birds by the wagon load. This incident seems to have been one of the final stages in the extermination of the pigeon.

The last warning of the rattler: GEORGE D. SMITH, Eastern Kentucky State Normal School. The paper describes a fight which the author observed between a diamond rattlesnake and a large blue racer. The fight was long and fierce and ended in the destruction of the rattler. During the fight the racer is badly bitten by the rattler, hastens to a patch of weeds and bites several of the weeds, sucking out the juice. He then hastens back to renew the combat. In the progress of the fight the juice of the weed was applied a second time and the racer rushed back to renew the fight as before.

Absorption in the corn grain: CHARLES A. SHULL, University of Kentucky.

Orthogenesis in the Membracidæ: W. D. FUNKHOUSER, University of Kentucky. The attempt to explain the remarkable developments of the pronotum in the family Membracidæ by natural selection fails in the cases of the most bizarre and curious tropical forms. Poulton and others have suggested explanations based on protective coloration and mimicry which must be carried into the realm of speculation when applied to certain exotic species. Certain genera, including *Heteronotus, Centrotus, Pyrgonota* and *Spongophorus,* seem to show very regular pronotal development along definite lines when traced from the more generalized to specialized forms. This is particularly true of the length and position of the suprahumeral, dorsal and posterior horns. These developments seem in many cases to be entirely without regard to utility and even to threaten the existence of the species. In comparison with the classical example of the Irish elk, many species of Membracidæ seem to show even greater evidence of orthogenesis.

The progress of Kentucky in the second decade of the twentieth century: EDWARD TUTHILL, University of Kentucky

Kentucky petroleum problems: LUCIEN BECKNER. Kentucky offers many problems in petroleum geology which the consulting geologist and the geologist of the private company seldom have time to solve. The larger anticlines, the Cincinnati, north and south, and the Kentucky, east and west, present their peculiar characters that are not yet well understood. The author points out many problems which, could they be solved, would save the useless expenditure of thousands of dollars and probably result in the production of much wealth.

The first food of young black bass: H. GARMAN, Experiment Station, Lexington, Ky. A study of the food by use of the microscope on the stomach contents of both large- and small-mouthed black bass, taken from the State Hatchery pools at Forks of Elkhorn, Kentucky, showed that the dietary of both species during the first five weeks of their active lives consists of small crustaceans belonging to the orders Cladocera and Entomostraca, and of insect larvæ belonging to the dipterous family Chironomidæ. The percentages of the different kinds of food were determined and, as far as practicable, an exact determination was made of the crustacean species most prevalent in the dietaries. The purpose of the study was to learn just what food was most relished and how it might be influenced artificially for the benefit of young fishes produced at the hatchery.

The tolerance of hogs for arsenic: D. J. HEALY and W. W. DIMOCK, Experiment Station, Lexington. There is a popular belief that hogs are not very susceptible to arsenical poisoning and an examination of the literature failed to disclose a record of arsenical poisoning in hogs. The results of four tests made by administering arsenic trioxid are given. The total of 11 shoats received large doses of arsenic trioxid; in some

cases the doses were enormous. Nine of the shoats received, in addition to the arsenic, hog cholera virus. One animal died from acute arsenical poisoning, one from acute cholera, and one from an undetermined cause. It would appear from these results that young hogs possess a marked tolerance for arsenic trioxid.

Growing seedlings in test tubes with only filter paper pulp and distilled water: Mary Didlake, Experiment Station, Lexington. The lower third of a test-tube is filled loosely with crumpled strips of filter paper, enough water to cover the paper is added and the tube plugged with cotton and sterilized in the autoclav. Sterilized seeds may be dropped in and allowed to germinate and grow. Soybean, cowpea, garden bean, garden pea, Canada field pea, vetch, alfalfa, red clover, Japan clover, velvet bean, peanut, locust, acacia, corn, wheat, hemp, and morning glory have been grown successfully in this way. Plants will grow thriftily for a month or six weeks.

Effect of frost and "soil stain" on the keeping quality of sweet potatoes: A. J. Olney, University of Kentucky. When the vines were cut away before frost, only 4 per cent. of the potatoes spoiled after storage at about 60 to 65° F. When the vines were cut immediately after a freeze, no loss occurred. When the vines were cut 5 days after the freeze the loss was 88 per cent. Potatoes badly affected with soil stain (*Monilochaetes infuscans*) but otherwise sound, sustained a loss of 55 per cent., while healthy checks suffered a loss of 12 per cent. Potatoes wrapped with paper sustained a loss of 20 per cent., as against 12 per cent. in those unwrapped.

Attempted inter-species crosses of the genus Nicotiana: G. C. Routt. Crosses were attempted among 7 species of *Nicotiana*. Of 911 flowers experimented with, 201 set seed. Only 4 of the 19 combinations proved fertile in both crosses and reciprocals, 4 proved fertile in one way only, and 11 proved infertile. Plants have not yet been grown from the seed obtained.

The production of antitoxin: Morris Scherago, University of Kentucky. The method of producing diphtheria and tetanus antitoxin is described from the time the flasks of media are inoculated for the production of the homologous toxin until the antitoxin is ready for distribution. The factors influencing the potency of a toxin are discussed and the method of estimating the M. F. D. is outlined. The immunization of horses is discussed including the types of animals desired, preliminary treatment, dosage and time of injection. The time for taking trial bleedings and regular bleedings is indicated and the standardization of antitoxin is briefly discussed. The method of concentrating antitoxin is also described and discussed.

The inefficiency of the efficiency expert: P. K. Holmes, University of Kentucky. Efficiency is the keynote in modern industry. Our modern "captains of industry" are giant efficiency experts. They often fail at the vital point because they do not apply their principles of efficiency to their own living, although they demand it of their employees who handle delicate machinery or assume big responsibilities for them. Big business can not long be efficiently done on artificial stimulants and by flabby muscles and shortness of wind. In the struggle for business supremacy only the strong survive. We must no longer be satisfied to live on a low health plane. We must have as our standard positive, and not negative, health. Such only is the basis of general efficiency.

On the trail of the Alaska salmon: Dr. Henry B. Ward, University of Illinois. The marvelous life history of the Alaska salmon has been worked out by the combined efforts of many investigators. In the early summer the adult fish appear off the coast, move forward into the inlets, start up stream, ultimately reach their spawning grounds, and having spawned, die. No adult salmon ever returns to salt water. The eggs rest in their gravel nests over winter and hatch out in the spring; the young fry play about in fresh water, descending slowly the streams until they disappear into the ocean. The markings on the scales carry a precise record of the age and wanderings of the fish in fresh water and in the ocean. Reasons for their movements in fresh water are not yet so well determined. The course they follow is very precise but the influences that direct it are still unknown. Partial explanations of the movements are to be found in the influences of the current of the stream and the temperature of the water. The application of these principles to special instances indicates the extent to which they serve to explain the complex problems involved in migration. The author described many of his observations while studying the salmon in Alaskan waters. He also brought out forcibly the importance of Alaska's natural resources, of which the salmon is one of the greatest.

Alfred M. Peter,
Secretary